Sprint Review 2
Visible Light Communication (VLC)
Advanced Wireless Communication

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Background and Motivation

- Visible Light Communication uses 430-770 THz which lies in the visible spectrum of humans.
- The transmitter is usually an LED which flickers faster than humans can perceive.
- The receiver is a photo detector which detects these minor changes in intensity and converts it to digital signal.

Background and Motivation

Key Objectives

- To implement a hybrid system of WiFi uplink and VLC downlink.
- To evaluate download data rate and websites loading time of the implemented system and compare it with that of the traditional WiFi.
- Able to transmit data through LED and receive the same data on the receiving end (to a photodetector).

Background and Motivation

Key Objectives

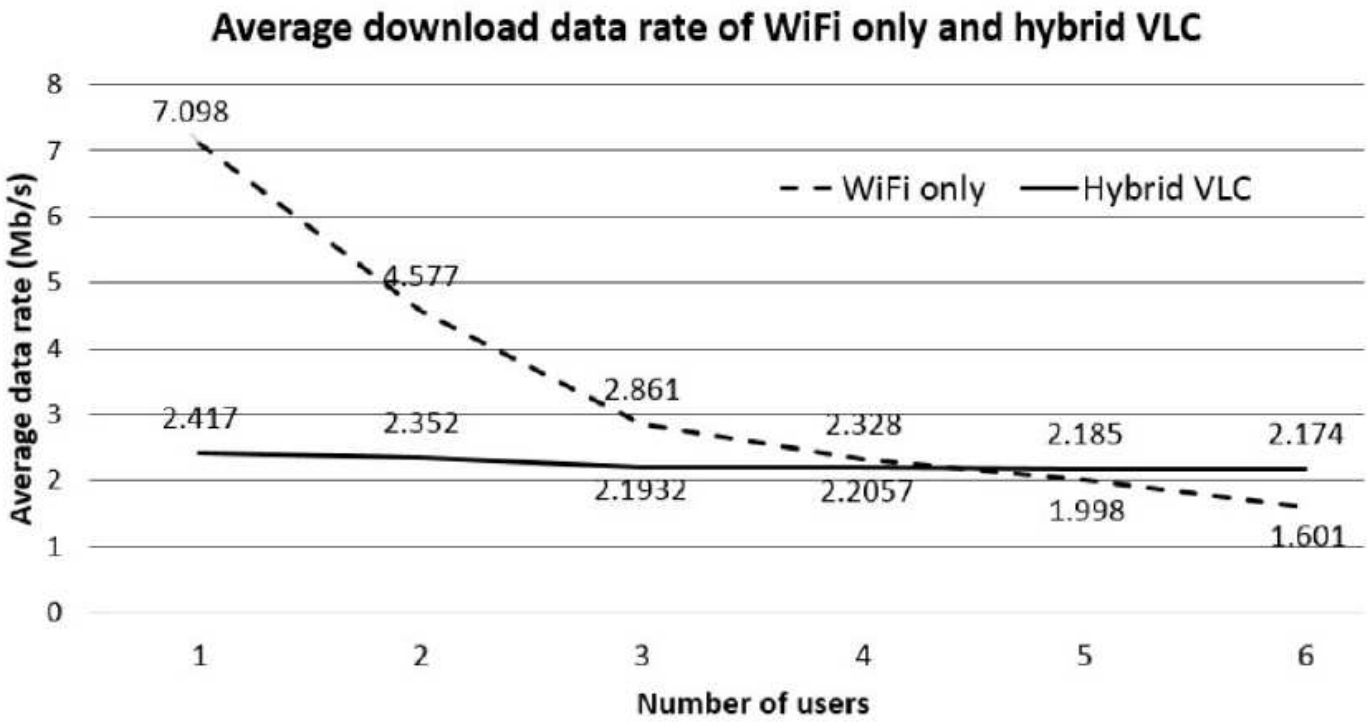

Figure : Comparing Download Data Rate[1]

[1] "An Indoor Hybrid WiFi-VLC Internet Access System - IEEE Xplore Document", Ieeexplore.ieee.org, 2017. [Online]. Available: http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=7035746. [Accessed: 18- Feb- 2017]

Background and Motivation

5 Metrics of Evaluation

- Current State of art study
- Individual Contribution
- Minimum Viable Product
- Social Context
- Impact of Work done

Summary of Sprint Review 1

- As a part of Sprint Review 1, analytical plots for channel gain, Received Power and SNR distribution were shown. [2]
- Comparison between average download data rate of WiFi and WiFi-VLC was shown graphically from the paper. [3]
- As a part of this project, we will demonstrate that it is possible to transmit data using Visible Light Communication.

2] V. Communication, "Visible Light Communication - File Exchange - MATLAB Central", In.mathworks.com, 2017. [Online]. Available: https://in.mathworks.com/matlabcentral/fileexchange/53179-visible-light-communication. [Accessed: 03- Feb- 2017].
[3] "An Indoor Hybrid WiFi-VLC Internet Access System - IEEE Xplore Document", Ieeexplore.ieee.org, 2017. [Online]. Available: http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=7035746. [Accessed: 18- Feb- 2017]

Current State of Project

Project Timeline

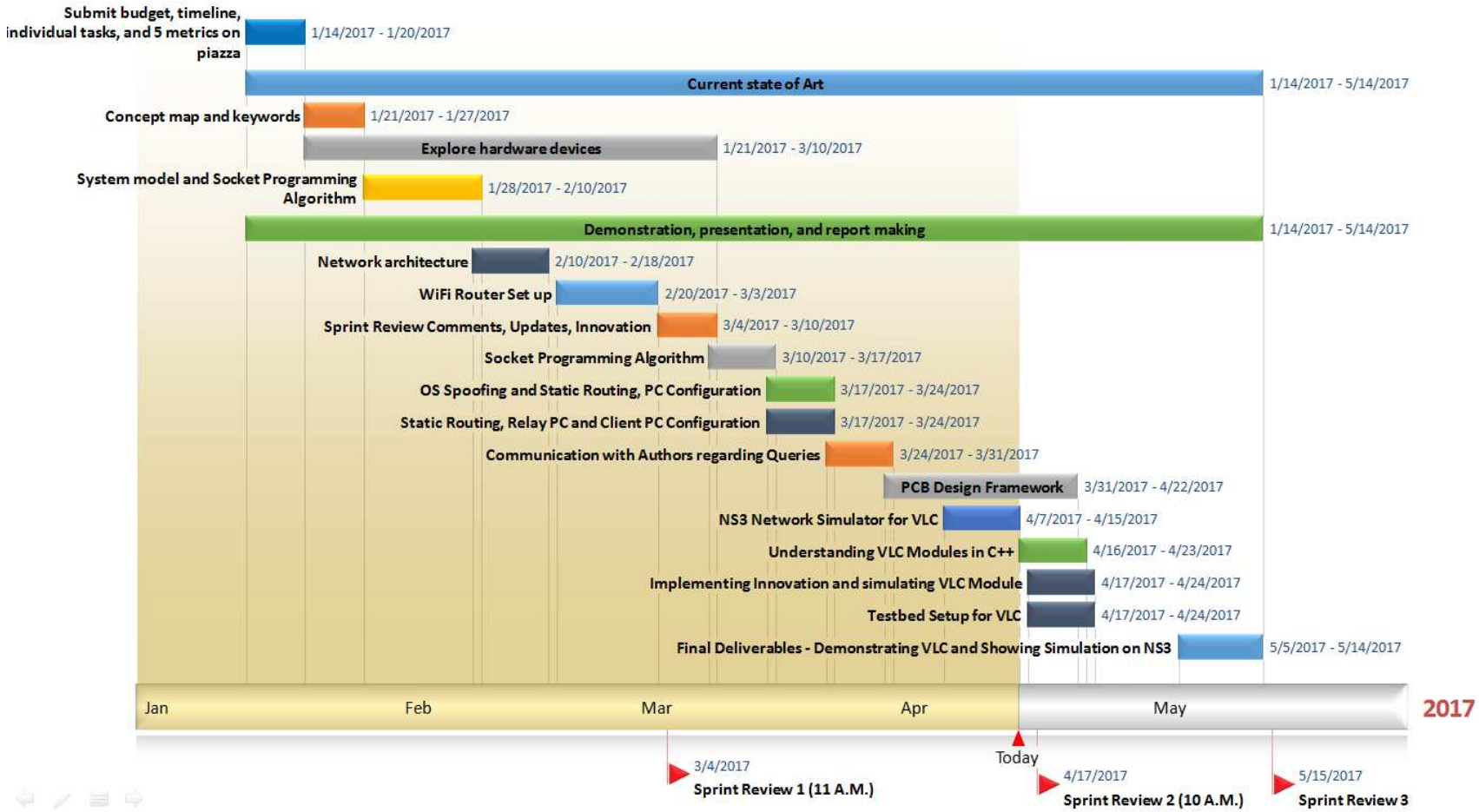

Figure : Project Timeline - Red Devils

The system will consist of 2 USRP (Universal Software Defined Radio Peripheral) devices, 1 WiFi router, 1 LED (transmitter), 1 photodetector (receiver), 1 relay PC, and 1 client PC.

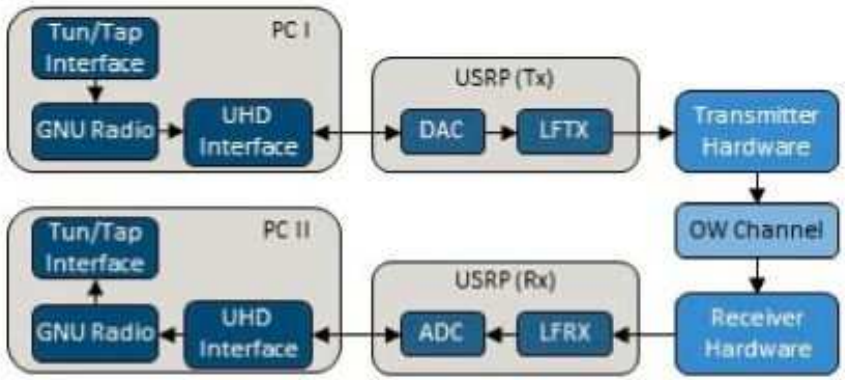

Figure : System Architecture

[4] "An Indoor Hybrid WiFi-VLC Internet Access System - IEEE Xplore Document", Ieeexplore.ieee.org, 2017. [Online]. Available: http://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=7035746. [Accessed: 18- Feb- 2017]

Current State of Project

Testbed Setup

- Photodetector - PDA36A
- Bias T - ZX85-12G-S+
- PCB Design - MOSFETs and LEDs
- USRP N210
- WiFi Router

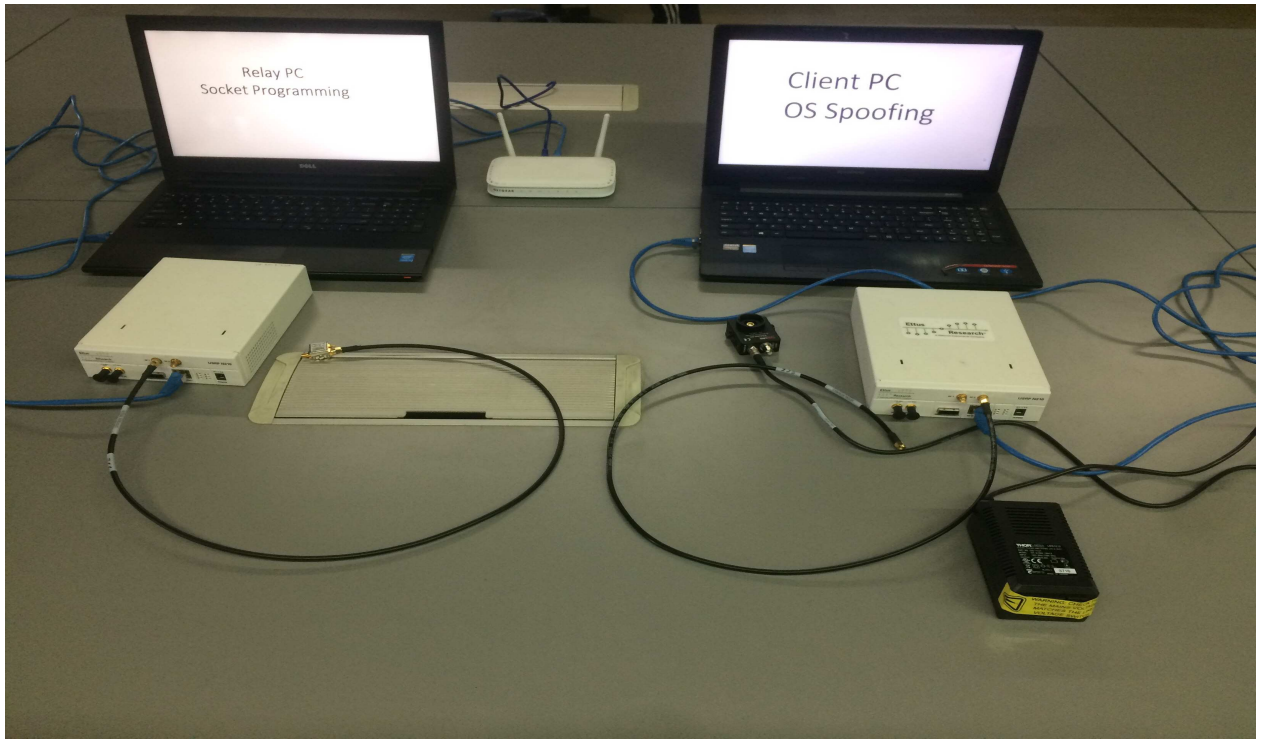

Figure : Testbed Setup Demonstration

Current State of Project

Simulation Framework

Parameter	Value
Transmited Power, P_t	48.573 dbm
Lambertian Order Semiangle, $\Phi_{1/2}$	70°
Filter Gain, T_s	1
Boltzmann's Constant, k	$1.3806e^{-23}$ J/K
Noise Bandwidth Factor, I_2	0.562
Background Current I_B	5100^{-6} A
Open-Loop Voltage Gain, G_{ol}	10
Fixed Capacitance Of Photo, C_{pd}	$112pF/cm^2$
Field-Effect Transistor (FET) Transconductance (gm)	30 mS
Electronic Charge, q	$1.60217e^{-19}$ C
I_3	0.0868
PhotoDetectorArea, A	$1.0e^{-4}$ m^2
Refractive Index, n	1.5
Field Of View, ψ_{con}	70°
Transmiter coordinate	(0.0,0.0,50.0)
Transmiter Azimuth	(0.0)
Transmiter Elevation	(180.0)
Receiver Coordinate	(0.0,0.0,dist)
Receiver Azimuth	(0.0)
Receiver Elevation	(0.0)
VPPM Duty Cycle, α	0.85, 0.6
Bandwidth Factor, b	1
Distance, d	50 m
Absolute Temperature, T_k	295 K
FET channel noise factor, Γ	1.5
PAM Modulation Order, M	4
Electric Filter Bandwidth	$5e^6$ b/s

Figure : Parameters for Simulation

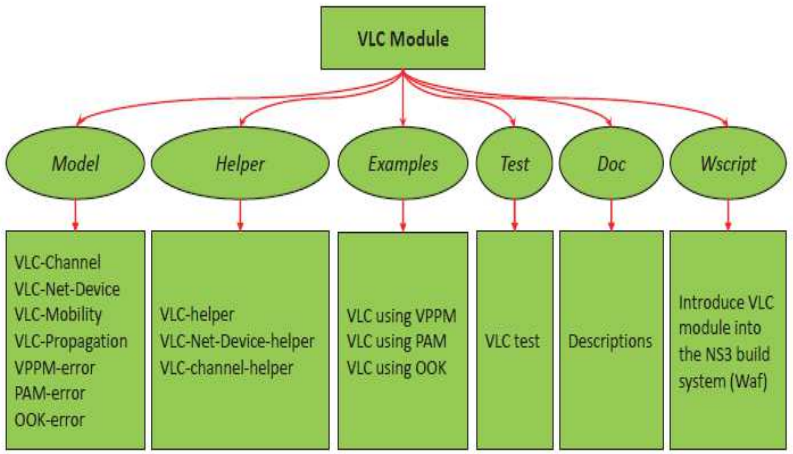

Figure : VLC Module Structure

[5] A. Aldalbahi et al., "Extending ns3 to simulate visible light communication at network-level," 2016 23rd International Conference on Telecommunications (ICT), Thessaloniki, 2016, pp. 1-6. doi: 10.1109/ICT.2016.7500485

Final Deliverables

- Demonstrating data transmission through Visible Light Communication using Hardware - USRPs, Transmitter and Receiver hardware with optical channel in between.
- Implementing Visible Light Communication module using NS3.
- SNR, BER and Throughput analysis

Final Deliverables

Technical Risks

- Hardware Failure
- Obstruction (Non-Line of Sight) between transmitter and receiver
- Poor performance in outdoor environments
- Increasing the distance can affect throughput.

Results

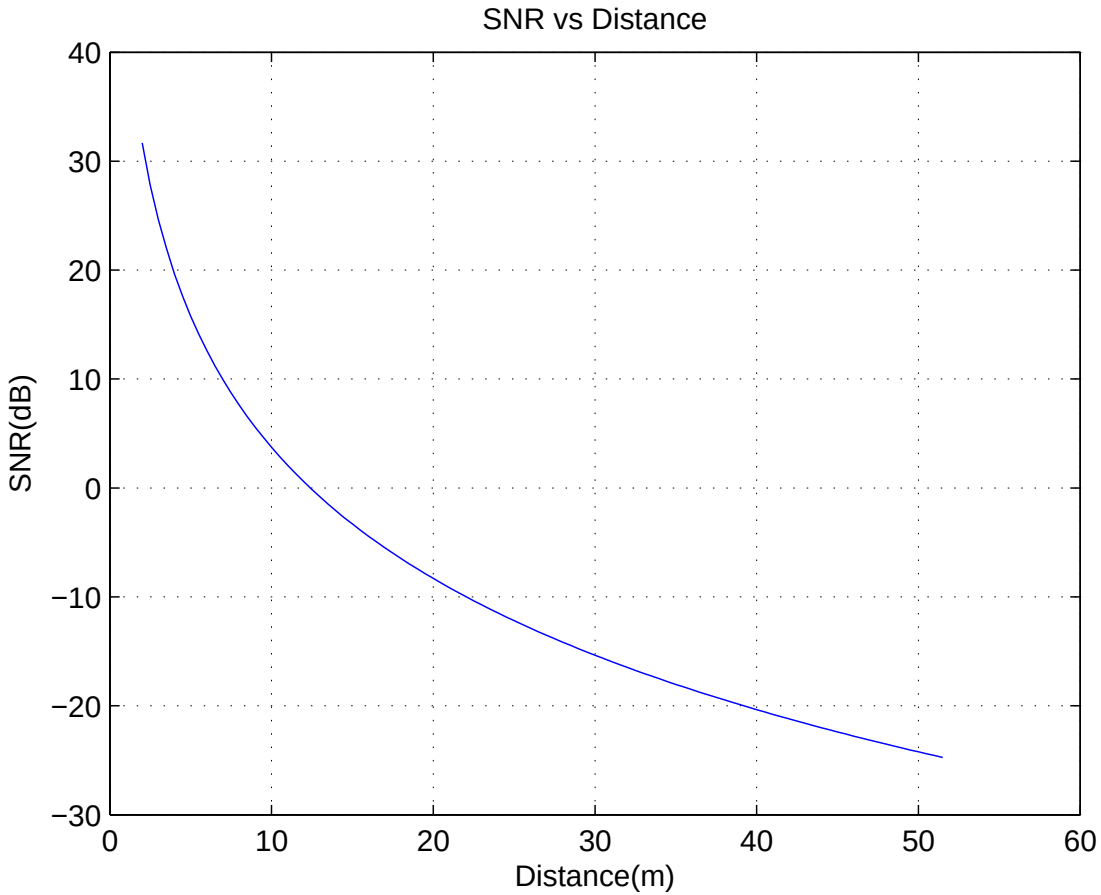

Figure : SNR versus Distance - NS3 Simulation

Results

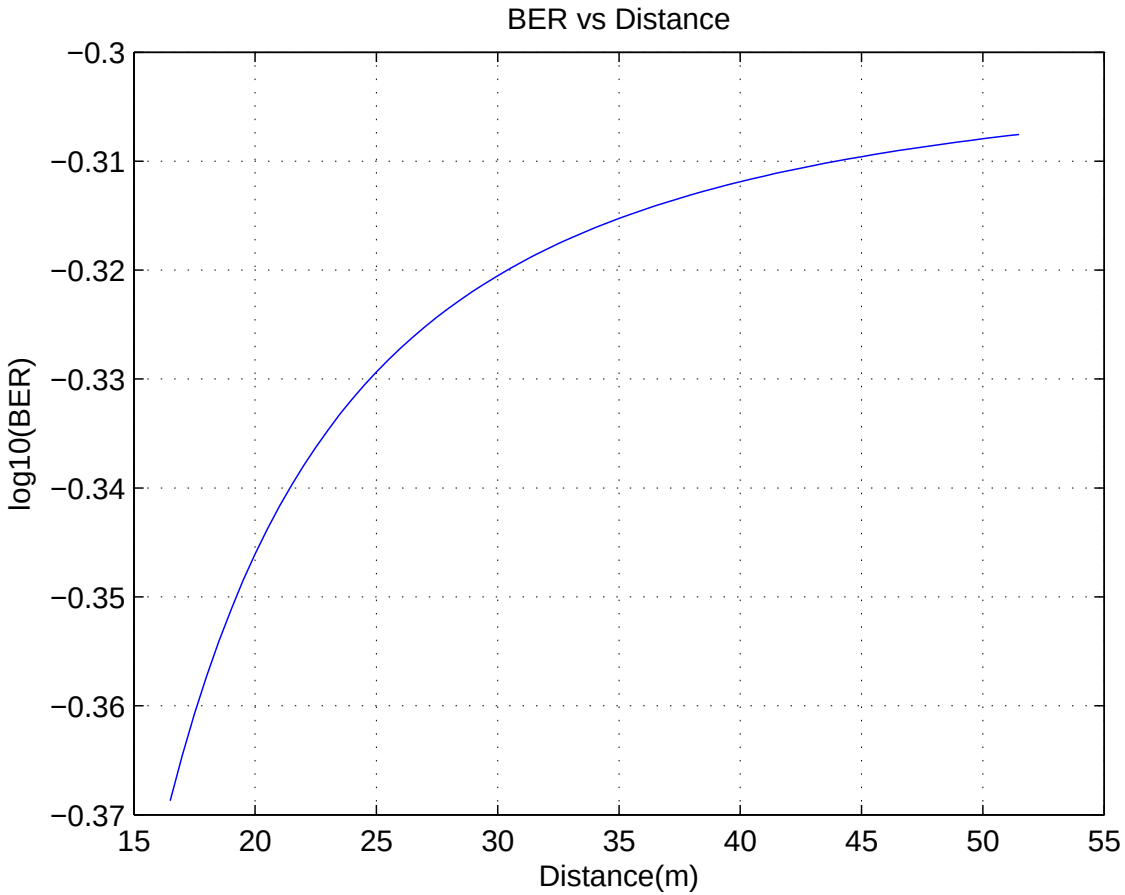

Figure : BER versus Distance - NS3 Simulation

THANK YOU